

CLAIMS:

1. A sample dispensing system comprising:
a dispensing pin having a tip and a sample chamber formed in the tip for holding
5 a predetermined volume of sample, a sample filling channel formed in the tip and in
fluid communication with the sample chamber for loading a liquid sample into the
sample chamber and a droplet ejection nozzle in fluid communication with the sample
chamber for ejecting a droplet of the liquid sample from the sample chamber; and
an actuator coupled to the sample chamber for forming the droplet upon
10 activation of the actuator.
2. The sample dispensing system of claim 1, wherein the tip has a diameter
between about 0.5 millimeters and about 5 millimeters.
- 15 3. The sample dispensing system of claim 2, wherein the tip has a diameter of about
1.0 millimeters.
4. The sample dispensing system of claim 1, further comprising a holder for
mounting the dispensing pin.
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5. The sample dispensing system of claim 4, further comprising a control circuit for
activating the actuator.
6. The sample dispensing system of claim 5, further comprising an electrical
25 connector for electrically connecting the control circuit and the actuator.
7. The sample dispensing system of claim 1, wherein the dispensing pin is formed
from a silicon wafer using a microfabrication technique.
- 30 8. The sample dispensing system of claim 1, wherein the filling channel is separate
from the ejection nozzle.
9. The sample dispensing system of claim 1, wherein the filling channel includes a
filling nozzle for introducing a liquid sample to the filling channel.
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10. The sample dispensing system of claim 9, wherein the filling nozzle extends beyond the ejection nozzle, such that when the tip is dipped into a reservoir, the filling nozzle is immersed in a liquid supply without immersing the ejection nozzle.
- 5 11. The sample dispensing system of claim 1, wherein the droplet ejection nozzle has an ejection port, said ejection port having a diameter between about thirty and about fifty microns.
- 10 12. The sample dispensing system of claim 1, wherein the actuator comprises a piezoelectric film affixed to a side wall of the sample chamber.
13. The sample dispensing system of claim 1, wherein the actuator comprises an electromechanical assembly for effecting ejection of a droplet from the ejection nozzle.
- 15 14. The sample dispensing system of claim 1, wherein the actuator comprises a magnetic assembly for effecting ejection of a droplet from the ejection nozzle.
15. The sample dispensing system of claim 1, wherein the actuator comprises a thermoelectric assembly for effecting ejection of a droplet from the ejection nozzle.
- 20 16. The sample dispensing system of claim 1, wherein the filling channel and the sample chamber have a combined volume of between about 1 nanoliter and about 10 nanoliters.
- 25 17. A droplet dispensing system, comprising:
a first pin having a tip; and
a dispensing pin having a tip and spaced adjacent to the first pin so as to form a sample filling channel between the first and second pin, the dispensing pin tip having a sample chamber located in fluid communication with the sample filling channel, an
30 ejection nozzle for ejecting a droplet from the sample chamber, and an actuator for triggering formation and ejection of a droplet from the ejection nozzle.
18. The droplet dispensing system of claim 17, wherein the first pin and the second
35 channel.

19. The sample dispensing system of claim 17, wherein the first pin tip and the dispensing pin tip have a diameter between about 0.5 millimeters and about 5 millimeters.
- 5 20. The sample dispensing system of claim 19, wherein the dispensing pin tip diameter is about 1.0 millimeters.
21. The sample dispensing system of claim 17, further comprising a holder for mounting the first pin and the dispensing pin.
- 10 22. The sample dispensing system of claim 21, wherein the holder contains a control circuit for activating the actuator.
- 15 23. The sample dispensing system of claim 22, further comprising an electrical connector for providing an electrical connection between the control circuit and the actuator.
24. The sample dispensing system of claim 17, wherein the first pin and the dispensing pin are formed from a silicon wafer.
- 20 25. The sample dispensing system of claim 17, wherein the filling channel includes a filling nozzle for introducing a liquid sample to the filling channel.
- 25 26. The sample dispensing system of claim 25, wherein the filling nozzle extends beyond the ejection nozzle, such that when the first pin tip and the dispensing pin tip are dipped into a reservoir, the filling nozzle is immersed in a liquid supply without immersing the ejection nozzle of the dispensing tip.
- 30 27. The sample dispensing system of claim 17, wherein the droplet ejection nozzle has an ejection port, said ejection port having a diameter between about thirty and about fifty microns.
28. The sample dispensing system of claim 17, wherein the actuator comprises a piezoelectric film affixed to a side wall of the sample chamber.
- 35 29. The sample dispensing system of claim 17, wherein the actuator comprises an electromechanical assembly for effecting ejection of a droplet from the ejection nozzle.

30. The sample dispensing system of claim 17, wherein the actuator comprises a magnetic assembly for effecting ejection of a droplet from the ejection nozzle.
- 5 31. The sample dispensing system of claim 17, wherein the actuator comprises a thermoelectric assembly for effecting ejection of a droplet from the ejection nozzle.
32. The sample dispensing system of claim 17, wherein the filling channel and the sample chamber have a combined volume of between about 1 nanoliter and about 10
10 nanoliters.
33. A method of forming and dispensing droplets of a liquid sample, comprising:
providing a droplet dispensing system comprising a pin having a tip, said tip forming a filling channel for filling the tip with a predetermined volume of liquid
15 sample, a sample chamber for holding a predetermined volume of liquid sample, an ejection nozzle and an actuator for effecting formation of a droplet from said volume of liquid sample; and
activating the actuator to produce a droplet of liquid sample at the sample ejection nozzle.
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34. The method of claim 33, further comprising the step of filling the tip with a liquid sample prior to the step of activating the actuator.
35. The method of claim 34, wherein the step of filling the tip comprises the step of
25 immersing the tip in a reservoir containing a supply of liquid sample.
36. The method of claim 35, wherein the step of immersing comprises immersing an intake port of the filling channel without immersing the ejection nozzle.
- 30 37. The method of claim 35, wherein the step of filling comprises activating the actuator to pump a liquid sample into the filling channel.
38. The method of claim 33, wherein the step of activating the actuator comprises transmitting a droplet ejection signal to the actuator from a control circuit.
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39. The method of claim 33, further comprising the step of directing the droplet of liquid sample to a fluid interface port.

40. A pin for use in a system for discharging droplets, comprising:
a tip;
a sample chamber formed in the tip for holding a predetermined volume of
5 sample;
a sample filling channel formed in the tip and in fluid communication with the
sample chamber for loading a liquid sample into the sample chamber; and
a droplet ejection nozzle in fluid communication with the sample chamber for
ejecting a droplet of the liquid sample from the sample chamber.
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41. The pin of claim 40, further comprising an actuator coupled to the sample
chamber for forming the droplet upon activation of the actuator.
42. A liquid sample dispensing system, comprising:
15 a holder;
an array of dispensing pins connected to the holder, each dispensing pin having a
tip and a sample chamber formed in the tip for holding a predetermined volume of
sample, a sample filling channel formed in the tip and in fluid communication with the
sample chamber for loading a liquid sample into the sample chamber and a droplet
20 ejection nozzle in fluid communication with the sample chamber for ejecting a droplet
of the liquid sample from the sample chamber; and
an actuator coupled to the sample chamber of one or more of the dispensing pins
for forming one or more droplets upon activation of the actuator.
- 25 43. A microfabricated sample dispensing system comprising:
a dispensing pin microfabricated on a silicon wafer, said dispensing pin having a
tip and a sample chamber formed in the tip for holding a predetermined volume of
sample, a sample filling channel formed in the tip and in fluid communication with the
sample chamber for loading a liquid sample into the sample chamber and a droplet
30 ejection nozzle in fluid communication with the sample chamber for ejecting a droplet
of the liquid sample from the sample chamber; and
an actuator coupled to the sample chamber for forming the droplet upon
activation of the actuator.